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SPECIFICATION

1. Title of the Invention:

Disk Recording and Regenerating Device

2. CLAIMS

A disk recording and regenerating device comprising a recording data generating means for appending addresses sequentially in block units to data to be recorded and inserting each address block between synchronizing signals to generate recording data signals in accordance with a predetermined recording format, disk recording and regenerating unit for recording and regenerating recording data signals generated by the recording data generating means on a writable disk using a pickup, end address value detecting means for detecting the end of a previously recorded part on a disk to which the recording data signal is being written and detecting the address value of an address block positioned at this end, subtraction address generating means for generating a subtraction address value obtained by subtracting a predetermined value from the end address value detected by the end address value detecting means, subtraction address value searching means for moving the pickup to the recording position of the subtraction address value, address match detecting means for regenerating the address at the position searched by the searching means and detecting when the address in the

regeneration signal matches the end address value, synchronizing signal detecting means for detecting a synchronizing signal from the regeneration signal during regeneration by the regenerating means, switching means for switching from a regenerating state to a recording state at the synchronizing signal part after the address block regeneration ends when an address match is detected by the address match detecting means, and additional recording preparing means for generating additional recording data via the recording data generating means during the regeneration period of the address match detecting means and sending the additional recording data to the disk record regeneration unit when switching to the recording state by the switching means.

3. DETAILED DESCRIPTION OF THE INVENTION

[OBJECT OF THE INVENTION]

[FIELD OF THE INVENTION]

The present invention relates to a disk recording and regenerating device for recording and regenerating information signals on a writable disk, and specifically relates to the capability of additional recording of new information contiguous to previously recorded information.

[DESCRIPTION OF THE RELATED ART]

Recently, there has been progress, for example, in developing disk recording and regenerating devices for recording information signals on optical disks and regenerating these information signals. Although various recording methods have been considered for such devices, in all cases additional recording must be possible. In this instance, in order to effectively use the recording capacity of the disk, it is desirable to detect the end of a

previously recorded part, so as to record the new information contiguously to the previously recorded information. In previously conceived methods, in order to prevent an additional recording part from being recorded over a previously recorded part, additional recording is accomplished from the end of a previously recorded part separated by a predetermined interval, as shown in part (a) of FIG. 5. When regenerating a disk recorded in this way, a blank part can be provided between data in the regeneration signal. In this case, when each information is regenerated consecutively, there is concern that tracking will dislocate at the blank part during regeneration, causing a breakdown in the synchronizing cycle and regeneration failure. Therefore, although methods which insert null data in the blank part have been considered, as shown in part (b) of the drawing, in all cases the data recording capacity of the disk is diminished.

[PROBLEM TO BE SOLVED BY THE INVENTION]

An object of the present invention is to improve the points of forming a blank part and inserting null data during additional recording as has been performed up to now by providing a disk recording and regenerating device capable of accurately performing additional recording contiguous to a previously recorded part so as to thereby substantially increase the disk recording capacity.

[CONSTITUENTS OF THE INVENTION]

[MEANS FOR SOLVING THE PROBLEMS]

That is, the disk recording and regenerating device of the present invention is characterized by comprising a recording data generating means for appending addresses sequentially in block units to data to be recorded and inserting each address block between synchronizing signals to generate recording data signals in accordance with a

predetermined recording format, disk recording and regenerating unit for recording and regenerating recording data signals generated by the recording data generating means on a writable disk using a pickup, end address value detecting means for detecting the end of a previously recorded part on a disk to which the recording data signal is being written and detecting the address value of an address block positioned at this end, subtraction address generating means for generating a subtraction address value obtained by subtracting a predetermined value from the end address value detected by the end address value detecting means, subtraction address value searching means for moving the pickup to the recording position of the subtraction address value, address match detecting means for regenerating the address at the position searched by the searching means and detecting when the address in the regeneration signal matches the end address value, synchronizing signal detecting means for detecting a synchronizing signal from the regeneration signal during regeneration by the regenerating means, switching means for switching from a regenerating state to a recording state at the synchronizing signal part after the address block regeneration ends when an address match is detected by the address match detecting means, and additional recording preparing means for generating additional recording data via the record data generating means during the regeneration period of the address match detecting means and sending the additional recording data to the disk record regeneration unit when switching to the recording state by the switching means.

[OPERATION]

The disk recording and regenerating device of the aforesaid structure detects the end address value among

previously recorded data, searches for the position at which a subtraction address value obtained by subtracting a predetermined value from the end address value is recorded, regenerates the address at the position searched by the searching means and detects when the address in the regeneration signal matches the end address value. Additional recording preparation is performed when a synchronizing signal is detected from the regeneration signal. Then, when an address match is detected, the device is switched from a regenerating state to a recording state at the synchronizing signal part after the regeneration of the address block is completed, and additional recording starts.

[EMBODIMENT]

An embodiment of the present invention is described below with reference to FIGS. 1 through 4. The following description pertains to an optical-type disk recording and regenerating device; the optical disk has a guide channel for tracking formed in a spiral shape from the inner circumference to the outer circumference, and the disk recording and regenerating device records and regenerates information signals by forming or detecting bits corresponding to information signals (data) by irradiating the guide channel on the disk via a beam of light, and this recording and regenerating is accomplished by the disk recording and regenerating unit.

FIG. 1 shows the structure of the device; reference number 11 in the drawing refers to a system controller for generally controlling the optical-type disk recording and regenerating device. The system controller 11 receives operation signals by the operation of operation switches (record, regenerate, stop, search and the like), and generates control signals suitably corresponding the

operation. Reference number 12 refers to an input pin for inputting the information signals S_{in} to be recorded, and the information signals S_{in} supplied to the input pin 12 are sent to a recording data generating circuit 13. The recording data generating circuit 13 generates sequential data from the input information signals when a recording preparation signal $F1$ described later is input, and the generated recording data are sent to a recording format encoder 14 each time a read instruction is supplied from the recording format encoder 14. After the recording format encoder 14 encodes the recording data so as to match a predetermined recording format and divides the data into blocks having constant periods (e.g., in the case of digital audio disk format, the interleave length becomes the block), an address is sequentially appended to each block and converted to an address block, a start signal is inserted at the top and the block-set recording data are output in a form inserted between synchronizing signals. The encoded recording data are sent to a recording data start detection circuit 15. After the recording data start detection circuit 15 detects the start signal at the top of the input data, a write counter 16 is started when a synchronizing signal of the recording format is detected, and the recording data are written to a buffer memory 17.

The buffer memory 17 temporarily stores the recording data, and writes sequential recording data in accordance with the write address from the write counter 16, and reads out sequentially written recording data in accordance with the read address from a read counter 18. The writing of the recording data is performed until a read stop control signal $SC1$ is supplied from the system controller 11. The recording data read out from the memory 17 is sent through an exclusive OR circuit (EX-OR circuit) 19 to a recording

start timing circuit 20. The recording start timing circuit 20 sequentially delays recording data based on a flag F5 described later, and sends the delayed recording data through an output pin 21 to a disk recording and regenerating unit not shown in the drawing. This disk recording and regenerating unit is set at the disk recording state, disk regenerating state, or regeneration search state in accordance with a pickup control signal SC2 output from the system controller 11, and is set at the recording state when there is recording data Dout input, and the recording data Dout is recorded on the disk.

On the other hand, reference number 22 in the drawing refers to a regeneration signal input pin, and this input pin 22 receives regeneration data Din read out from a disk via the aforesaid disk recording and regenerating unit. The regeneration data Din is sent to an RF signal detection circuit 23 and an address decoder 24. The RF signal detection circuit 23 detects the existence of a signal during regeneration, and when a signal exists, sends the detected data signal to an address counter 25, synchronizing counter 26, synchronizing signal latch circuit 27, and the system controller 11. Furthermore, the address decoder 24 decodes the address in the regeneration data signal, and outputs the address value to the address counter 25.

The address counter 26 sets the end address value of the regeneration signal received from the RF signal detection circuit 23 and a value calculated by subtracting a predetermined value from this end address value, sends the recording preparation signal F1 to the recording data generating circuit 13, recording data start detection circuit 15, write counter 16, and read counter 18 to set the recording preparation state, and sends an address search instruction signal F2 to the system controller 11 to start

an address search. Then, when the subtracted address value and the address value in the regeneration data signal match, the address search instruction signal F2 is replaced by a regeneration instruction signal F3 to accomplish normal regeneration, and at the same time the subtraction address value is reset and a start signal F4 is sent to the synchronizing counter 26.

The synchronizing counter 26 is set at a drive state by the start signal F4 from the address counter 25, an internal synchronizing loop counter is started by a synchronizing signal within the regeneration data signal to synchronize the loop with the synchronizing signal. A trigger pulse is generated at the start of the obtained synchronizing signal, and this pulse is counted until a predetermined value set in the address counter 25, and thereafter a flag F5 is set, the read counter 18 and the recording start timing circuit 20 are actuated, and data are read out from the buffer memory 17. At the same time, a generated trigger pulse P0 is sent to a synchronizing signal latch circuit 27. The synchronizing signal latch circuit 27 latches the polarity of the start bit of the synchronizing signal via the pulse P0 from the synchronizing counter 26, and suitably reverses the output of the EX-OR circuit 19 in accordance with the latched polarity.

The operation of the previously described structure is described below with reference to FIGS. 2 through 4.

FIG. 2 shows the structure of the recording data (regeneration data) when generated in the format of a digital audio disk, and the recording data generated by the recording data generating circuit 13 are formatted in blocks by the recording format encoder 14, and a synchronizing signal and address are appended to provide address blocks. Formats such as those for video disks and the like may be

similarly considered to insert address signals in data. A half-cycle synchronizing signal is added to the end recording data thus converted.

FIG. 3 is a flow chart showing the flow of the entire operation of the aforesaid device. That is, when additional recording is specified in this device (step a), first, a pickup for recording and regeneration on the disk is set to the regenerating state, track jump and regeneration are repeated, the last recording track of the previous recording is searched, and thereafter the track jumps to the last recording track or several tracks therefrom in the direction of recording (step b), and the end address value of the previous recording is read (step c). The aforesaid operation is accomplished by means of the RF signal detection circuit 23, address decoder 24, address counter 25, and system controller 11.

The end address value of the regeneration data obtained in this way is sent to the address counter 25. At this time, the address counter 25 sets the input address value and a subtraction value a predetermined value from this address value, sends an address search instruction signal F2 to the system controller 11, track jumps the pickup, and searches for the set subtraction address value (step d). Then, when an address value matching the set subtraction address value is detected by the address search (step e), a recording preparation signal F1 is sent to the recording data generation circuit 13, recording data start detection circuit 15, write counter 16, and read counter 18. In this way, the recording data Sin are rendered as data in a sequential predetermined format and written to the buffer memory 17. At this time, the address counter 25 replaces the address search instruction signal F2 with a regeneration instruction signal F3 sent to the system controller 11. In

this way, the pickup is set at the normal regenerating state. When regenerating to the end of previously recorded data (step f), a recording start signal F4 to the synchronizing counter 26 when the address counter 25 detects the same address as the set previously recorded end address value.

When a start signal F4 is input, the synchronizing counter 26 generates a flag F5, which is sent to the read counter 18 when recording starts at the next synchronizing signal position. The read counter 18 starts operation when the flag F5 is input, and sequentially reads the data stored in the buffer memory 17. The read data are sent to the EX-OR circuit 19. The latch circuit 27 latches the polarity of the first bit of the synchronizing signal from the regeneration data Din via the trigger pulse P0 output from the synchronizing counter 26. If the latched polarity is high level, the recording data sent from the buffer memory 17 are reverse output, whereas when the polarity is low level, the recording data are output directly. The recording data output from the EX-OR circuit 19 are sent to the recording start timing circuit 20, which aligns the regeneration data Din and synchronizing timing, and the recording data are sent to the disk recording and regenerating unit for recording on the disk.

Thereafter, when the stop switch is operated, the system controller 11 sends a stop control signal SC1 to the memory 17, and readout of the memory 17 is stopped at the half-cycle of the synchronizing signal. In this way, a half-cycle signal can be added to the end of the recording data Dout. The time of the recording data output of the recording start timing circuit 20 may be set as shown in FIG. 4. As shown in part (a) of the drawing, when the half-cycle signal at the end of the regeneration data Din is "0" level (bit is not formed with the recording laser off), recording

data are output from before the half-cycle of the synchronizing signal period. Conversely, when the half-cycle signal at the end of the regeneration data Din is "1" level, the recording data are output after the half-cycle of the synchronizing signal period, as shown in part (b) of the drawing. In this way, the additional recording part and the previous recording part can be joined without destroying the synchronizing signal.

Therefore, according to the above-described structure, when recording additional data on a disk, additional recording data can be recorded contiguous to previously recorded data without forming blank parts between written data and without destroying the synchronizing signal in the written data. In this way, tracking dislocation is eliminated, and regeneration is smoothly accomplished continuously from the inner circumference side to the outer circumference side, thereby effectively increasing the writing capacity of the disk.

[EFFECT OF THE INVENTION]

As described above, the present invention provides a disk recording and regenerating device capable of accurately recording an additional part contiguous to a previously recorded part, and thereby substantially increases data storage capacity.

4. BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block circuit diagram showing an embodiment of the disk recording and regenerating device of the present invention; FIG. 2 illustrates the structure of the recording data in a suitable recording format of the same embodiment; FIG. 3 is a flow chart showing flow of the entire operation of the same embodiment; FIG. 4 illustrates the regeneration and recording switch timing of the same

embodiment; and FIG. 5 illustrates the pattern of the regeneration data of a conventional device.

- 11 System controller
- 13 Recording data generating circuit
- 14 Recording format encoder
- 15 Recording data start detection circuit
- 16 Write counter
- 17 Buffer memory
- 18 Read counter
- 19 EX-OR circuit
- 20 Recording start timing circuit
- 23 RF signal detection circuit
- 24 Address decoder
- 25 Address counter
- 26 Synchronizing counter
- 27 Synchronizing signal latch circuit
- Sin Information signal
- SC Operation signal
- Dout Recording data
- Din Regeneration data
- F1 Additional recording preparation signal
- F2 Address search instruction signal
- F3 Regeneration instruction signal
- F4 Recording start signal
- F5 Flag
- P0 Trigger pulse

回路19から出力される記録データは記録開始タイミング回路20に送られ、再生データD1aと同期タイミングを合わせてディスク記録再生装置部に送られ、ディスクに記録される。

その後、停止スイッチが操作させると、システムコントローラ11は停止制御信号SC1をメモリ17に送り、メモリ17の読出しを同期信号の半周期時点で停止させる。これによって、記録データDoutの末尾に半同期信号を付加することができる。

ここで、上記記録開始タイミング回路20の記録データ出力時点は、第4図に示すように設定すればよい。すなわち、同図(a)に示すように、再生データD1aの末尾にある半同期信号が“0”レベル(記録レーザオフによりビットが形成されていない状態)であるとき、同期信号期間の半周期前から記録データを出力する。逆に、同図(b)に示すように、再生データD1aの末尾にある半同期信号が“1”レベルであるとき、同期信号期間の半周期後から記録データを出力する。これによ

って、既記録部分と追記記録部分を、同期信号をくずすことなく繋げることができる。

したがって、上記のように構成すれば、ディスクにデータの追記記録を行なう際、書き込んだデータ間に空白部を形成することなく、また書き込んだデータ中の同期信号を崩すことなく、既記録データと連続して追記記録データを記録することができる。これによってトラッキングがはずれるようなことはなくなり、また連続的に内周側から外周側まで再生がスムーズにいくようになり、結果的にディスクに書き込む容量を増したことになる。

【発明の効果】

以上詳述したようにこの発明によれば、既記録部分に続いて正確に追記記録を行なうことができ、これによって実質的にデータ記憶容量を増加することができるディスク記録再生装置を提供することができる。

4. 図面の簡単な説明

第1図はこの発明に係るディスク記録再生装

置の一実施例を示すブロック回路構成図、第2図は同実施例に適用される記録フォーマットのによる記録データの構成を説明するための図、第3図は同実施例の全体の動作の流れを示すフローチャート、第4図は同実施例の再生記録切換タイミングを説明するための図、第5図は従来装置による再生データのパターンを説明するための図である。

11—システムコントローラ、13—記録データ生成回路、14—記録フォーマットエンコーダ、15—記録データスタート検出回路、16—書き込みカウンタ、17—バッファメモリ、18—読出しカウンタ、19—EX-OR回路、20—記録開始タイミング回路、23—RF信号検出回路、24—アドレスデコーダ、25—アドレスカウンタ、26—同期カウンタ、27—同期信号ラッチ回路、S1a—情報信号、SC—操作信号、Dout—記録データ、D1a—再生データ、F1—追記記録準備信号、F2—アドレスサーチ指令信号、F3—再生指令信号、F4—記録スタート信号、F5—フラグ、P0—トリガパルス。



